



Map of Potential Restoration Sites and Habitat Limiting Factors

This map was produced by multiple database queries using Geographic Information System (GIS) data developed under the North Coast Watershed Assessment Program (NCWAP). The data are available to the public.

Use this map to quickly locate:

- Limiting factors for salmonid habitat in surveyed streams
- Streams that were surveyed in 2001
- Areas upslope of stream reaches in which embeddedness is a limiting factor
- Potential sediment sites in upslope areas that may be contributing to embeddedness or shallow pool depths

The following data were used:

- California Geological Survey (CGS) landslide data
- CGS fluvial sediment mapping
- Department of Fish and Game (DFG) in-stream habitat surveys
- California Department of Forestry and Fire Protection (CDF) mapping of historic roads that were either in streams or near streams
- University of California Information Center for the Environment (ICE) roads map of the current roads in the watershed

The map shows:

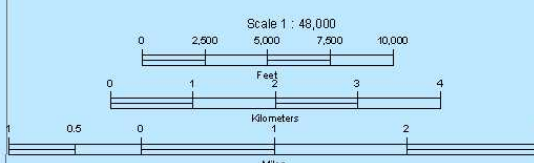
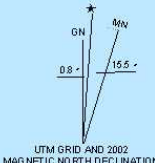
- Segments of the modern roads that cross or are within 60 meters of a historically active landslide
- Segments of the modern roads that are both within 60 meters of historically active landslides and within 60 meters of eroding stream banks
- The segments of the modern roads that are within 60 meters of dormant landslides
- The segments of historic in-stream or near stream roads that may be active sediment sources
- Areas upslope of stream reaches in which embeddedness is a limiting factor
- The limiting factors for salmonids for each stream reach that was surveyed
- The extent of the DFG stream surveys in 2001

The DFG stream surveys indicate that pool depth and pool shelter in many of the streams are primary limiting factors. In-stream structures can be built to create scour pools, riffles, and shelter that will enhance channel habitat complexity. In-stream structures can also meter sediment transport. NCWAP recommends that the construction of in-stream structures be considered in the development of a restoration plan.

Embeddedness can result from erosion of fine-grained sediment from in-stream, stream bank, and upslope sources. Reduction of the fine sediment load across entire upslope areas may be needed to reduce the embeddedness of spawning gravels in those stream reaches where embeddedness is a limiting factor. Most of the roads in the Gualala River watershed are unpaved ranch and forest roads. To the degree that roads are a significant contributor of fine-grained sediment, road improvements can reduce generation of fine sediment generation. The map shows the upslope areas drained by the streams, surveyed in 2001 by DFG, in which embeddedness was a limiting factor. The survey was limited to the stream reaches indicated on the map. Additional habitat surveys are needed to determine whether the unsurveyed areas possess any limiting factor. The map also identifies potential road related sediment sources in each subbasin that may be good remediation targets for the reduction of fine sediment generation. Historically active landslides are shown as additional sediment source areas. Potential road related sediment sites are shown based on the premise that elevated loads of fine sediment from roads can be mitigated. NCWAP recommends field investigation of the potentially road related sediment sites within areas upslope of reaches with embeddedness as a limiting factor. The investigation should verify the actual site conditions and propose road improvements and erosion control as needed.

LIMITATIONS:

Landslide and fluvial geomorphology information on this map is based on observations from aerial photos. Field checking for landslide and fluvial geomorphology data was extremely limited. The aerial photography represents conditions as of April 2001. On-site evaluation is needed to confirm actual conditions. No cause and effect relationships are implied. Stream habitat information of this map is based on field measurements and observations made by DFG as of 2001. Only the stream reaches highlighted to show a limiting factor were surveyed. Other areas were not visited.



- Roads
- Streams
- Watershed boundary
- Sub-basin boundary
- Historically Active Landslides (mapped as a point if too small to delineate at the scale of this map)

I SPATIALLY ASSOCIATED FACTORS DERIVED FROM AERIAL PHOTO INTERPRETATION OF LANDSLIDING AND SEDIMENT CONDITIONS

A HISTORIC IN-STREAM ROADS POSSIBLY RELATED TO FLUVIAL SEDIMENT

- Stream reaches with persistent grading or braiding in both 1984 and 2000 photos that may be associated with historic in-stream roads or landings. See recommendation #5.

B ROADS POSSIBLY RELATED TO LANDSLIDES AND/OR ERODING BANKS

- Road segments that may be affected by historically active landsliding and bank erosion. See recommendation #6.
- Road segments that may be affected by historically active landsliding. See recommendation #7.

C FLUVIAL SEDIMENT CONDITIONS POSSIBLY RELATED TO LANDSLIDES

- Stream reaches with potentially adverse sediment accumulations that may be affected by historically active landslides and lack any apparent association with the modern road network or the historic in-stream roads or landings. See recommendation #8.
- Stream reaches with potentially adverse sediment accumulations that may be affected by erosion from adjacent dormant landslide terrain that lack any apparent association with historically active landsliding, the modern road network, and historic in-stream roads or landings. See recommendation #9.

D POTENTIALLY UNRELATED FLUVIAL SEDIMENT CONDITIONS

- Stream reaches with potentially adverse sediment accumulations that lack any of the above associations. See recommendation #9.

II LIMITING FACTORS DERIVED FROM GROUND BASED HABITAT SURVEYS (SEE DFG APPENDIX)

- CANOPY AND POOLS AS LIMITING FACTORS (All stream reaches surveyed by DFG in 2001 are highlighted as follows. Reaches that were not surveyed in 2001 are not highlighted on the map.)

- Stream reaches with inadequate canopy cover as the limiting factor. See recommendation #2.
- Stream reaches with inadequate pool depths as the limiting factor. See recommendation #4.
- Stream reaches with inadequate pool shelter as the limiting factor. See recommendation #3.
- Stream reaches with both inadequate pool depths and shelter as primary limiting factors. See recommendations #3 and #4.

Explanation

B EMBEDDEDNESS AS A LIMITING FACTOR

- Areas draining into where embeddedness conditions are unknown.
- Areas draining into reaches where embeddedness is not limiting.
- Areas draining into reaches where embeddedness is marginal but not limiting.
- Areas draining into reaches where embeddedness is somewhat limiting. See recommendation #1.
- Areas draining into reaches where embeddedness is significantly limiting. See recommendation #1.

RECOMMENDATIONS BASED ON LIMITING FACTORS

- Reduce production of fine sediment throughout the contributing area. Evaluate contribution from roads and upgrade roads as appropriate. Evaluate contribution from soil disturbance and control erosion as appropriate (see recommendations 5-10). Evaluate contribution from soil disturbance and control erosion as appropriate. Consider the additive effect of the short-term increases in erosion due to mitigation activities. Distribute individual activities both spatially and temporally as appropriate to avoid additive sediment impacts. Institute best management practices in erodible areas, such as, areas shown on the CGS Relative Landslide Potential Map (Plate Two), and Natural Resources Conservation Service soil maps.
- Enhance current riparian vegetation by planting additional trees, and stabilize stream banks as needed. Also, consider both downstream and upstream effects.
- Enhance pool shelter by adding submerged or partially submerged structures. Consider both upstream and downstream effects due to operation and possible failure.
- Install in-stream structures to produce hydraulic variability and to scour pools. Consider both downstream and upstream effects due to operations and possible failure.

RECOMMENDATIONS BASED ON SPATIAL ASSOCIATIONS

- Evaluate relationship on-site. Consider channel restoration and drainage improvements for the road and landing. Consider engineered abandonment.
- Evaluate relationship on-site. Consider road drainage improvements to prevent saturation of slide area. Consider abandonment or realignment where feasible. Consider stream bank stabilization where feasible.
- Evaluate relationship on-site. Consider road drainage improvements to prevent saturation of slide area. Consider abandonment or realignment where feasible.
- Evaluate on-site whether these represent natural background conditions. If mitigation is desired, road construction may be needed for equipment access.
- No recommendation because potentially associated active sediment sources have not been identified.

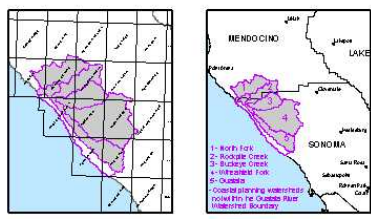


PLATE 3 POTENTIAL RESTORATION SITES AND HABITAT LIMITING FACTORS FOR THE GUALALA RIVER WATERSHED

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